

Confocal Studies of Colloidal Glasses

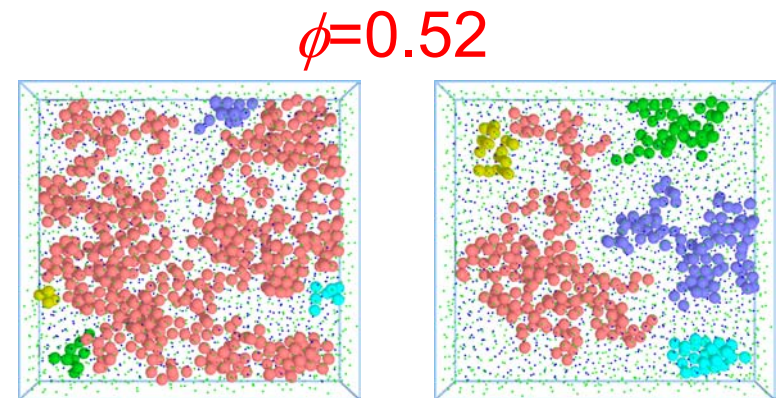
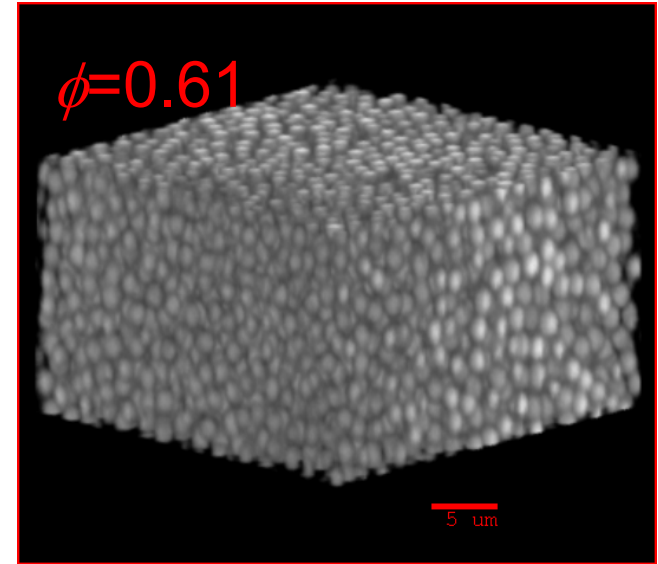
David A. Weitz, Harvard University, DMR-0243715

We study the phase behavior of dense colloidal suspensions. Colloidal suspensions share the phase behavior of atomic systems and are excellent model systems in which to study phase behavior. We use a colloidal model system to study the glass transition, which occurs at a high volume fraction ϕ of particles. At $\phi=0.58$, the dynamics of the system slow by many orders of magnitude, and a disordered solid forms.

We fluorescently label colloidal particles and then image with confocal microscopy in three dimensions, as shown at right. Using image analysis techniques, we locate individual particles to within fifty nanometers and follow their motions for thousands of seconds.

We study samples at volume fractions both below and above the colloidal glass transition. We identify static particles as those with no nearest-neighbor rearrangements over fixed lag times. We find that the static particles are inhomogeneously localized into clusters. The lifetime of the clusters increases as the volume fraction is increased towards the glass transition. These static regions may bear stresses macroscopically.

The measurements provide insight into the nature and origin of elasticity in the glass transition.



→
increasing time

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Brief summary of outreach activities:

Educational:

7 undergraduates currently in the group

13 grad students currently in the group

12 post-docs currently in the group

Note that 4 of the undergrad students, 5 of the grad students, and 3 of the post docs in the group are women.

With Seth Fraden, I have founded a series of meetings for the New England area soft condensed matter community, found online at www.complexfluids.org. Quarterly meetings are held at area universities, including UMass-Amherst, Brown, Yale, UMass-Boston, Boston University, MIT, as well as Brandeis and Harvard. Meetings typically have over eighty participants, of which the majority are students and postdocs. These meetings provide an excellent educational opportunity for all participants.

Industrial:

Several of the post docs working on my NSF-funded research are funded in part by grants from industry. This ensures that our work directly impacts important technology, to help maintain the competitiveness of US industry. In addition, it ensures that the work we do has direct practical significance. It also leverages the NSF support, allowing it to be focused on training undergraduate and graduate students.

The companies we work with include:

Proctor and Gamble

Rhodia USA

Infineum

Kraft

Halliburton

BASF